

**REMARKS**

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claims 1, 2 and 7 are currently being amended.

This amendment changes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1-9 are now pending in this application.

**Claim Objections**

Claim 7 was objected to for including the phrase “maintain this closure.” In response, Applicant has amended claim 7 to replace the phrase “maintain this closure.” with “maintain closure of the contact” as suggested by the Examiner. Accordingly, Applicant respectfully requests that the objection be withdrawn.

**Claim Rejections - 35 U.S.C. § 103(a)**

On page 2 of the Office Action, the Examiner rejected Claims 1-9 as being unpatentable over U.S. Patent No. 6,518,764 titled “Relay Driving Apparatus” to Shirato (“Shirato”) in view of U.S. Patent No. 6,493,204 titled “Modulated Voltage for a Solenoid Valve” to Glidden (“Glidden”) under 35 U.S.C. § 103(a).

The Examiner stated that:

Shirato discloses relay driving apparatus; the apparatus (fig. 6) comprising: a control unit (31) configured to control an electromagnetic relay (15, 16), the control unit generates a pulse-width modulation (PWM) signal according to a voltage supply; at least one contact (SW) controlled by the control unit, the control unit is configured to control the at least one contact according to the voltage supply (col. 11, lines 21-40); the control unit is configured to provide a contacting voltage (“movable time” in fig. 7A) to the relay, the contacting

voltage is sufficient to close the at least one contact (col. 11, lines 21-40); the control unit is configured to provide according to the voltage supply, a maintaining voltage ("A/B" slots in fig. 7A) sufficient to maintain closure of the at least one contact (fig. 7A).

However, the Examiner acknowledged that Shirato does not disclose "the control unit having a calculator for changing a cyclic ratio value of the pulse duration modulator for supplying the maintaining voltage." *See* Office Action at p. 3.

The Examiner stated that Glidden discloses "a control unit (microprocessor, 35) generates a PWM voltage having a constant frequency and variable duty cycle and the frequency of the PWM voltage is selected to be compatible with the response time of a solenoid (40) (col. 5, line 64 - col. 6, line 19)."

The Examiner concluded that "[i]t would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a microprocessor since today they are cheap, small and easily available to be used as a circuit part to control the relay. Also since the microprocessor is able to conduct arithmetic operations, it reads on the calculator in the claim."

The combination of Shirato and Glidden does not identically disclose the combination of elements recited in independent Claims 1, 2 and 7 as amended. Shirato is directed to a "Relay Driving Apparatus" including a controller that "supplies the base of the transistor Q5 with a pulse signal S80 which has been subjected to predetermined pulse width modulation thereby controlling the transistor to carry out the on-operation (supplying the rated voltage to the relay coil RL1) or the off-operation (intercepting the supply of the rated voltage to the relay coil RL1)." *See* Shirato at Col. 11, lines 14-20; and Figure 6. Glidden is directed to a circuit for actuating an ABS solenoid valve coil with a pulse modulated voltage. *See* Abstract.

Claim 1 as amended is in independent form and recites an "electromagnetic relay" comprising, in combination with other elements, a "pulse duration modulator for supplying a contacting voltage or a maintaining voltage wherein the pulse duration modulator is configured to modulate the pulse-width modulation signal according to: [a] at least one of the

voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay; wherein the pulse duration modulator is configured to modulate the pulse-width modulation signal according to: [a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact.”

Claim 2 as amended is in independent form and recites a “control unit for an electromagnetic relay coupled to a voltage source” comprising, in combination with other elements, “a control unit” that “generates a pulse-width modulation signal,” “wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay; wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact.” Claims 3-6 depend from independent Claim 2.

Claim 7 is in independent form and recites an “electronic circuit” comprising, in combination with other elements, a “control-command unit,” “wherein the control-command unit modulates the power supply according to: [a] at least one of a voltage supply and a current supply and [b] the contacting voltage which is sufficient to close a contact of the relay; wherein the control-command unit modulates the power supply according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the contact.” Claims 8 and 9 depend from independent Claim 7.

The voltage applied across an electromagnetic relay coil typically generates a current exciting an electromagnet which closes the contact of the relay or keeps it closed. The coil then dissipates thermal energy, on the order of several watts. The contact itself, when closed, permits passage of an electric current and also dissipates thermal energy. The claimed electromagnetic relay, control unit and electronic circuit can be configured to permit a relay to operate in acceptable thermal and operational conditions, including in a confined environment

(e.g., electronic service boxes) due to the modulation of the pulse width modulation signal as specified in the claims above.

Shirato and Glidden, alone or in combination, do not identically disclose an “electromagnetic relay” comprising, in combination with other elements, a “pulse duration modulator for supplying a contacting voltage or a maintaining voltage wherein the pulse duration modulator is configured to modulate the pulse-width modulation signal according to: [a] at least one of the voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay” and “wherein the pulse duration modulator is configured to modulate the pulse-width modulation signal according to: [a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact” (Claim 1) or a “control unit for an electromagnetic relay coupled to a voltage source” comprising, in combination with other elements, a “a control unit” that “generates a pulse-width modulation signal,” “wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay” and “wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact” (Claim 2) or an “electronic circuit” comprising, in combination with other elements, a “control-command unit,” “wherein the control-command unit modulates the power supply according to: [a] at least one of a voltage supply and a current supply and [b] the contacting voltage which is sufficient to close a contact of the relay” and “wherein the control-command unit modulates the power supply according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the contact.” (Claim 7)

Shirato discloses “the controller 31 supplies the pulse signal S80 to the base of the transistor Q5 to supply the relay coil RL1 with the rated current with which the movable iron piece 15 is moved and attached to the iron core 16, and then supplies the relay coil RL1 with the holding current to keep the attachment state after the movable iron piece 15 is attached to the iron core 16.” *See* Shirato at Col. 11, lines 59-65.

With regard to claim 1, Shirato does not disclose “modulat[ing] the pulse-width modulation signal according to: [a] at least one of the voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay” and “modulat[ing] the pulse-width modulation signal according to: [a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact.” Instead, to supply a rated current, Shirato sets the pulse signal S80 to periodically have a logical level of “Hi” and to supply a holding current, Shirato sets the pulse signal S80 to alternately switch its logic level between “Hi” and “Lo.” *See* Shirato Col. 11, lines 47-56. More specifically, Shirato does not modulate the pulse-width modulation signal according to both of “[a] at least one of the voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay.” Moreover, Shirato does not disclose modulating the pulse-width modulation signal according to both of “[a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact.”

Glidden discloses the application of a Pulse Width Modulated (PWM) control signal having a constant frequency and a variable duty cycle. *See* Col. 5, line 64-Col. 6, line 5. Glidden discloses that initially, a PWM signal having a 100% duty cycle and a voltage of 5 V is generated. *See* Co. 5, lines 20-25. However, this is not “modulat[ing] the pulse-width modulation signal according to [a] at least one of the voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay” as claimed in claim 1. Next, Glidden discloses “generating a PWM control signal having *a first predetermined duty cycle* selected to cause an average current to flow through the coil” which is not identical to “modulat[ing] the pulse-width modulation signal according to [a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact” as claimed in claim 1. Like Shirato, Glidden fails to modulate the pulse-width modulation signal according to both of “[a] at least one of the voltage supply and current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay.” Further, Glidden does not disclose modulating the pulse-width

modulation signal according to both of “[a] at least one of the voltage supply and current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact.”

Similarly, with regard to claims 2 and 7, Shirato and Glidden, alone or in combination, also fail to identically disclose “a control unit” that “generates a pulse-width modulation signal,” “wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the contacting voltage which is sufficient to close the at least one contact of the electromagnetic relay” and “wherein the pulse-width modulation signal is modulated according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the at least one contact” (Claim 2) and a “control-command unit,” “wherein the control-command unit modulates the power supply according to: [a] at least one of a voltage supply and a current supply and [b] the contacting voltage which is sufficient to close a contact of the relay” and “wherein the control-command unit modulates the power supply according to: [a] at least one of the voltage supply and the current supply and [b] the maintaining voltage which is sufficient to maintain closure of the contact.” (Claim 7) Accordingly, the rejection of Claims 1, 2 and 7 in view of Shirato and Glidden is improper. Thus, independent Claims 1, 2 and 7 are patentable over Shirato and Glidden.

Dependent Claims 3-6, 8 and 9, which depend from one of independent Claims 1, 2 or 7 are also patentable. See 35 U.S.C. § 112 ¶ 4.

Thus, the Applicants respectfully request withdrawal of the rejection of Claims 1-9 under 35 U.S.C. § 103(a).

\* \* \*

It is submitted that each outstanding objection and rejection to the Application has been overcome, and that the Application is in a condition for allowance. The Applicants request consideration and allowance of all pending Claims 1-9.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing or a credit card payment form being unsigned, providing incorrect information resulting in a rejected credit card transaction, or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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